20597

S/147/61/000/001/006/016
E031/E135

Fuselage Bending Calculations in the Region of a Mid-wing Junction

the functions φ_i is obtained from the potential energy and the Euler equations for the variational problem. This leads to a differential equation of the form already encountered. The maximum supplementary stresses are 9.5% of the maximum fundamental stresses on the boundary between the front and central sections and 28% of these stresses on the boundary between the central and rear sections. The supplementary tangential stresses are determined from the equilibrium condition. The supplementary stresses diminish the bending moments in a reinforces frame along its whole perimeter. The correctness of the present simple method was verified experimentally on a model of circular section loaded by normal bending stresses which obeyed the plane law at its ends. Theoretical and experimental investigations show that the reinforced frames are relieved of their loading as the cross-section becomes less and less plane.
There are 11 figures.

SUBMITTED: August 1, 1960
Card 4/4

KAN, S.N. (Kar'kov)

Prestressed concrete shells. Stroi. mekh. i rach. soor. 3 no.3:1-6 '61. (MIRA 14:6)
(Roofs, Shell) (Prestressed concrete)

28817

S/147/61/000/003/006/017
E191/E381

10.6000 1327

AUTHORS: Kan, S.N. and Silant'yev, A.V.

TITLE: The analysis of a fuselage in torsion in the region of the central plane

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Aviatsionnaya tekhnika, no. 3, 1961, pp. 56 - 68

TEXT: The stressed state of a fuselage of circular cross-section is considered in the region of the wing under torsion. Peripheral fixing of the central plane of the wings to the fuselage has been assumed. The use of the elementary formula for the shear stresses in free torsion leads to substantial errors. Appreciable normal stresses arise in the transverse cross-section of the fuselage. The main cause for constrained torsion is the stiffness of the fuselage stringers in their planes. It follows that a change of shape takes place in the transverse cross-section. This change of shape is a function of the position of the cross-section and causes normal and shear stresses. The fuselage is considered as a multiply statically indeterminate system. The basic statically determined system is a design with

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S/147/61/000/003/006/017
E191/E381

The analysis of a fuselage ....

the shear stresses of free unconstrained torsion. The fuselage is simplified into a beam supported on end frames through two load-carrying and a set of ordinary stringers in the central plane. Simultaneously, with the shear stresses of the skin, stresses are observed also in the longitudinal cross-section of the system if the stringers are considered as supported by the end frames and loaded with the increments of the shear forces in the skin. In the initial system of forces, additional forces of interaction between sections of the skin arise as well as those between the stringers and the skin. The conditions of compatibility of deformation will be fulfilled if the additional stresses are taken into account. The static indeterminacy is eliminated by the Castigliano method. It is assumed that the end frames, taking into account the associated fuselage skin, have a large flexural stiffness. The basic stresses are determined. As a rule, they lead to warping of the cross-sections. To remove the warping which does not in fact take place beyond the limits of the central cross-section, additional stresses are postulated. These are found from the condition of compatibility of deformation of the

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The analysis of a fuselage S/147/61/000/003/006/017
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central fuselage section with those of the front and rear sections. The analysis leads to a complete solution for the supplementary stresses. A numerical example given, derived from typical conditions, shows that the more refined stressing yields about 15% higher stresses in a shear and substantial normal stresses.
There are 11 figures.

ASSOCIATION: Khar'kovskoye vyssheye aviatsionnoye inzhenernoye voyennoye uchilishche (Khar'kov Military Aviation Engineering College)

SUBMITTED: October 24, 1960

Card 3/3

KAN, S.N., doktro tekhn.nauk, prof. (Khar'kov)

Thermoelasticity and stability of a circular cylindrical sandwich shell. Rasch.prostr.konstr. no.7:73-100 '62. (MIRA 15:4)
(Sandwich construction)

33708
S/198/62/008/001/001/005
D299/D302

10.6000 1327

AUTHOR: Kan, S. N. (Kharkiv)

TITLE: Transverse bending of circular cylindrical shells

PERIODICAL: Prykladny mekhanika, v. 8, no. 1, 1962, 3-10

TEXT: Practical formulas are derived for calculating ordinary and sandwich circular shells. Arbitrary support conditions are assumed and the external transverse load can vary in both longitudinal and transverse direction; in a particular case, the shell may be loaded by concentrated stresses. The normal stresses σ_z are determined as well as the tangential stresses q in the transverse-cross section elements. Simultaneously, the elementary circular sections (rings) are calculated, formed by the planes perpendicular to the z-axis. The shell is considered as a statically indeterminate system. In the calculations, additional forces are taken into account, namely those of interaction between the membranes and the shell, and between the rings. The solution of the problem is simplified by expressing all the unknown internal stresses in terms of the bending

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S/198/62/008/001/001/005
D299/D302

Transverse bending of ...

moments m_φ and the radial displacements u_n. The statical indeterminacy is solved on the basis of the minimum condition of potential energy of the system. The proposed applied method of calculation is based on Hooke's law and two hypotheses: 1) The absence of shears in the middle surface, and 2) non-deformability in the peripheral direction. In carrying out the calculation, it is assumed that the basic system of equations has been already solved (i.e. the quantities σ_z, q, m_φ, Q_φ, σ_φ and u have been found); it is required to find the additional stresses, displacements and moments ($\sigma_{m\ ad}$, q_{ad}, etc.). The radial additional displacement is

$$u_{ad} = \xi_{n\,ad}(z)\cos n\varphi \tag{2}$$

where $\xi_{n\ ad}(z)$ is a statically indeterminate function which varies

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D299/D302

in the longitudinal direction. The equilibrium equation of a shell element and the internal stress-strain relation of this element make it possible to determine all the additional stresses which arise in the structure. Thus, the additional normal stresses are

$$\sigma'_{z\ ad} = \frac{E}{1 - \mu^2} \frac{\partial w_n}{\partial z} \qquad (10)$$

The total bending moments are

$$m_{\varphi\ tot} = D(\varkappa_\varphi + \mu\varkappa_z) \qquad (12)$$

X

where D is the rigidity and $\varkappa$ the curvature. In order to fully solve the problem, it is necessary to determine the function $\xi_n(z)$; this function is found by solving Euler's equation for the variational

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problem (the potential energy of strain should be a minimum). Euler's equation leads to a differential equation in the unknown function $\psi_n(z)$, viz.:

$$\frac{d^4\psi_n(z)}{dz^4} + 4k_n^4\psi_n(z) = 4k_n^4 A_n(z) \qquad (24)$$

where

$$k_n^4 = \frac{n^4(n^2 - 1)^2 D}{4R^6 E\delta_{CT}} \qquad (25)$$

(δ_{CT} being the thickness). In practical problems, the bending moment m_φ has to be expanded in series:

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Transverse bending of ... S/198/62/008/001/001/005
D299/D302

ASSOCIATION: Kharkivs'ke vyshche inzhenerne aviatsiyne uchylyshche (Kharkiv Aviation Engineering Institution)

SUBMITTED: September 20, 1961

X

Card 6/6

S/198/62/008/002/002/011
D299/D301

24.4200
16.7500

AUTHOR: Kan, S.N. (Kharkiv)

TITLE: Stability and free oscillations of circular cylindrical sandwich shells

PERIODICAL: Prykladna mekhanika, v. 8, no. 2, 1962, 120 - 131

TEXT: The critical transverse load p_{cr} and axial stresses σ_{cr} of circular sandwich shells are determined, as well as the frequencies of the free oscillations of the shell. The problem is solved by the applied method, developed by the author in an earlier work (Poperechnyy zhyn kruhovykh tsylindrychnykh obolonok, Prykladna mekhanika, v. 8, no. 1, 1962). Thereby the displacements of the elements of the deformed system and the internal stresses are determined in terms of the transverse bending moment

$$m_\varphi = \Psi(z) \cos n\varphi, \quad (1)$$

where $\Psi(z)$ is a function yet to be determined. This function is found from the condition of minimum of the system's potential energy, allowance being made for the potential of the external stresses,

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D299/D301

One obtains

$$\Psi(z) = C_1 \mathrm{ch}\gamma_1 z + C_2 \mathrm{sh}\gamma_1 z + C_3 \cos\gamma_2 z + C_4 \sin\gamma_2 z, \quad (8)$$

where the integration constants C_1, C_2, C_3 and C_4 are determined by the boundary conditions. The following cases are considered: a) The shell is freely supported, b) it is rigidly clamped; c) one edge is supported and the other -- clamped; d) the edges are free. For case a) one obtains:

$$p_{cr} + \sigma_{cr}\delta_{CT}\left(\frac{m\pi}{L}\right)^2 \frac{(n^2+1)R}{n^2(n^2-1)} = \frac{D_s(n^2-1)}{R^3}\left[1 + \left(\frac{m\pi}{L}\right)^4 \frac{R^6 E\delta_{CT}}{D_s n^4(n^2-1)^2}\right] \quad (10)$$

where D_s is the rigidity (shear deformation being taken into accant) δ_{CT} is the thickness, and $n = 2, 3, 4, \ldots$ and $m = 1, 2, 3, \ldots$ are (respectively) the number of waves and halfwaves, (chosen in such a way, so as to correspond to the minimum of the critical load). From Eq. (10) it is evident that the presence of the axial stress σ_{cr} leads to a decrease in p_{cr}, and conversely. If the shear deforma-

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$$(\gamma_2^2 + \gamma_1^2)^2 \mathrm{sh}\, \gamma_1 L \sin \gamma_2 L = 0. \qquad (36)$$

Hence one obtains the equation for the frequency of free oscillations:

$$\omega^2 = \frac{\left(\frac{m\pi R}{L}\right)^4 + \frac{D_s}{ER^2\delta_{CT}} n^4(n^2 - 1)^2}{\frac{R^2\gamma\delta_{tot}}{gE\delta_{CT}}\left[\left(\frac{m\pi R}{L}\right)^2 + n^2(n^2 + 1)\right]}. \qquad (37)$$

For sufficiently long shells, Eq. (37) reduces to

$$\omega^2 = \frac{gD_s}{R^4\gamma\delta_{tot}} \frac{n^2(n^2 - 1)^2}{(n^2 + 1)}. \qquad (38)$$

Analogous expressions are obtained in the case of rigidly clamped shells, and for shells with nonsymmetrical edge-conditions. The

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agreement between the obtained working-formulas and the existing solutions for one-layer shells, is proof of the great accuracy of the proposed method. It is also noted that the shear deformation of the core affects considerably the results. There are 2 figures.

ASSOCIATION: Kharkivs'ke vyshche inzhenerne aviatsiyne uchylyshche (Kharkiv High Institution of Aviation Engineering)

SUBMITTED: September 20, 1961

S/124/62/000/008/022/030
I054/I254

AUTHOR: Kan, S.N.

TITLE: Temperature stresses in a circular conical shell

PERIODICAL: Referativnyy zhurnal, Mekhanika, Svodnyy tom. no. 8V, 1962, 11-12, abstract 8V83 (Tr. Konferentsii po teorii plastin i obolochek, 1960," Kazan', 1961, 164-169)

TEXT: The calculation of thermoelasticity of shells by energy method is given. The problem is solved as a multiple-statically undetermined system. For a basic static solution, a construction is applied in which the deformation of the cross-sectional planes and the interactions are neglected. Additional stresses appear from actual interactions and they are represented by a new-defined function, which is determined by a solution of a variation problem. Three examples are considered.

[Abstracter's note: Complete translation.]

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S/779/61/000/006/002/003
I071/242

10.6100

AUTHOR: Kan, S.N., Prof., Dr. of Technical Sciences (Kharkov)

TITLE: Stiffness of closed and open cylindrical shells

SOURCE: Raschet prostranstvennych konstruktsiy; sbornik statey, no.6, Moscow, 1961, 213-248

TEXT: An approximate method for computation of cylindrical and prismatic open and closed shells is given. Support conditions are arbitrary. The outside normal load may be variable along and across the shell or concentrated. The shell is considered as statically multiply indeterminate. The computation is carried out as for the elementary, thin walled, beam with constant section, corrected by supplementary results yielded by the bending theory. The superposition takes into account the conditions of compatibility of deforma-

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S/779/61/000/006/002/003
I071/I242

Stiffness of closed...

tions. The following cases are considered: circular section, clamped or free supported, with or without diaphragms (at ends or in the middle) for various loads; general open or closed prismatic or cylindrical sections. Eight examples are computed in detail and compared: 1. Circular cylinder, freely supported, under uniformly distributed load along one generator. 2. Elliptical cylinder with inner pressure. 3. Bridge with symmetric longitudinal load, with or without diaphragms. 4. One-span, freely supported, open cylindrical shell with side elements. 5. As in 4 but of double length. 6. As in 5 but with diaphragm in the middle. 7. As in 6 but with support under the diaphragm. 8. As in 4 but clamped. There are 10 references.

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SAVIN, G.N., otv.red.; ADADUROV, R.A., red.; ALUMYAE , N.A., red.; AMBARTSUMYAN, S.A., red.; AMIRO, I.Ya., red.; BOLOTIN, V.V., red.; VOL'MIR, A.S., red.; GOL'DENVEYZER, A.L., red.; GRIGOLYUK, E.I., red.; KAN, S.N., red.; KARMISHIN, A.V., red.; KIL'CHEVSKIY, N.A., red.; KISELEV, V.A., red.; KOVALENKO, A.D., red.; MUSHTARI, Kh.M., red.; NOVOZHILOV, V.V., red.; UMANSKIY,A.A., red.; FILIPPOV, A.P., red.; LISOVETS, A.M., tekhn. red.

[Proceedings of the Second All-Union Conference on the Theory of Plates and Shells]Trudy Vsesoiuznoi konferentsii po teorii plastin i obolochek.2d,Lvov, 1961.Kiev, Izd-vo Akad.nauk USSR, 1962. 581 p. (MIRA 15:12)

1. Vsesoyuznaya konferentsiya po teorii plastin i obolochek. 2, Lvov, 1961.

(Elastic plates and shells)

Kan, S.N.

BOROVSKIY, P. V. PHASE I BOOK EXPLOITATION SOV/6206 75

Konferentsiya po teorii plastin i obolochek. Kazan', 1960.

Trudy Konferentsii po teorii plastin i obolochek, 24-29 oktyabrya 1960. (Transactions of the Conference on the Theory of Plates and Shells Held in Kazan', 24 to 29 October 1960). Kazan', [Izd-vo Kazanskogo gosudarstvennogo universiteta] 1961. 426 p. 1000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Kazanskiy filial. Kazanskiy gosudarstvennyy universitet im. V. I. Ul'yanova-Lenina.

Editorial Board: Kh. M. Mushtari, Editor; F. S. Isanbayeva, Secretary; N. A. Alumyae, V. V. Bolotin, A. S. Vol'mir, N. S. Ganiyev, A. L. Gol'denveyzer, N. A. Kil'chevskiy, M. S. Kornishin, A. I. Lur'ye, G. N. Savin, A. V. Sachenkov, I. V. Svirskiy, R. G. Surkin, and A. P. Filippov. Ed.: V. I. Aleksagin; Tech. Ed.: Yu. P. Semenov.

PURPOSE: The collection of articles is intended for scientists and engineers who are interested in the analysis of strength and stability of shells.

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Transactions of the Conference (Cont.) SOV/6206

COVERAGE: The book is a collection of articles delivered at the Conference on Plates and Shells held in Kazan' from 24 to 29 October 1960. The articles deal with the mathematical theory of plates and shells and its application to the solution, in both linear and nonlinear formulations, of problems of bending, static and dynamic stability, and vibration of regular and sandwich plates and shells of various shapes under various loadings in the elastic and plastic regions. Analysis is made of the behavior of plates and shells in fluids, and the effect of creep of the material is considered. A number of papers discuss problems associated with the development of effective mathematical methods for solving problems in the theory of shells. Some of the reports propose algorithms for the solution of problems with the aid of electronic computers. A total of one hundred reports and notes were presented and discussed during the conference. The reports are arranged alphabetically (Russian) by the author's name.

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S/147/62/000/004/008/019
E031/E113

AUTHORS: Kan, S.N., and Lipovskiy, D.Ye.

TITLE: Stability of circular cylindrical frameworks under axial compression and transverse pressure

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Aviatsionnaya tekhnika, no.4, 1962, 79-90

TEXT: This is the first of three articles. The calculations are based on the assumption of a structurally orthotropic shell, the force elements being "smeared out". The energy method is used to calculate the critical stresses and it is assumed that under the action of the critical external forces the system has both a straight line and a curved form of equilibrium, corresponding to the minimum potential energy. The usual assumptions of the theory of thin shells are made. Considering first the critical stresses for the axial form of the loss of stability, the necessary condition for the minimum potential energy leads to a fourth order differential equation whose characteristic equation has roots $\lambda = \pm (\alpha \pm \beta i)$. The displacements can increase without limit if either $\alpha = 0$ or $\beta L = m\pi$, where L is the length of the shell.

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From the first condition can be obtained the critical axial compressive stress; the second condition gives the number of half-waves m along the generators at the loss of stability. The transverse pressure has no effect on the critical stresses. In the case of a non-axial form of the loss of stability, the assumption that the cross-sectional axis remains fixed and the condition for periodicity are used to give an expression for the tangential displacements, and the axial displacements are obtained from the condition that the mean surface is not displaced. Using these relations and the expression for the potential energy of unit length of the cylinder, Euler's equation leads to a fourth order differential equation which has the same complementary function as the previous equation. From the condition $\alpha = 0$ it is deduced that positive (internal) pressure increases the critical stress and negative pressure diminishes it. The condition $\beta L = m\pi$ gives a relation between the number of half-waves m along the generators and the number n of waves round the circumference at loss of stability. Expressions for the critical stresses may be obtained similarly for other boundary conditions. For the axial form of the loss of stability the critical stresses increase with

Stability of circular cylindrical... S/147/62/000/004/008/019
E031/E113

the strengthening of the longitudinal elements, whereas in the non-axial form it is the transverse elements which are important. There are 3 figures.

SUBMITTED: March 19, 1962

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KAN, S. N.

AID Nr. 989-6 13 June

STABILITY, AND STATIC AND DYNAMIC STRENGTH OF CIRCULAR CYLINDRICAL SANDWICH SHELLS (USSR)

Kan, S. N. IN: Raschet prostranstvennykh konstruktsij; sbornik statey, vyp. 8 (Design of three-dimensional structures; collection of articles, no. 8). Moskva, Gosstroyizdat, 1962, 69-83. S/779/62/000/008/002/006

Problems in designing circular cylindrical sandwich shells -- the flexure, stability, and vibration -- are discussed under the assumption that there is distortion in the cross-sectional contour of the shell. The conventional hypothesis of infinite rigidity of the core layer in the radial direction and zero rigidity in other directions is accepted. The flexure of a thin sandwich shell stiffened by circular frames rigid in their planes is investigated under arbitrary loading and support conditions. Expressions are derived for normal and tangential displacements, variations in the curvature of the middle surface in axial and circumferential directions, and for normal and tangential forces and bending moments.

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AID Nr. 989-6 13 June

STABILITY, AND STATIC AND DYNAMIC STRENGTH [Cont'd] S/779/62/000/008/002/006

The stability of the shell is analyzed, and the principle of the minimum potential energy is used to derive a general equation describing its buckling behavior. Formulas for critical pressures and stresses are obtained in particular cases of shell support by applying the appropriate boundary conditions. The free vibrations of the shell are examined with structural damping neglected and the body forces regarded as an external loading. Expressions for determining the modes of vibration and their frequencies are derived by using the energy method applied to the state of static equilibrium. The vibrational behavior of simply supported and clamped shells is examined, and design formulas are given. [VK]

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AID Nr. 989-3 13 June

KAN, S.N.

STRENGTH, STABILITY, AND LOAD-CARRYING CAPACITY OF CONSTRUCTIONALLY ORTHOTROPIC CYLINDRICAL SHELLS (USSR)

Kan, S. N. IN: Raschet prostranstvennykh konstruktsiy; sbornik statey, vyp. 8. (Design of three-dimensional structures; collection of articles, no. 8). Moskva, Gosstroyizdat, 1962, 85-106. S/779/62/000/008/003/006

The problems of flexure, stability (within and beyond the elastic range) under radial pressure and uniform axial compression, and load-carrying capacity of constructionally orthotropic cylindrical shells are investigated. Cylindrical shells stiffened by stringers and circular frames and shells made from corrugated sheets are discussed, with the effect of the stiffening (or of corrugation) taken into account by introducing equivalent thicknesses and flexural rigidities in both axial and circumferential directions. In analysis of the flexure the method of designing plain cylindrical shells is used, with Poisson's ratio put equal to zero and the different rigidity characteristics emphasized. The axisymmetrical and asymmetrical modes of buckling are discussed, and the effect of different rigidities on stability is explained. A numerical sample analysis of stability of a stiffened shell is given,

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AID Nr. 989-3 13 June

STRENGTH, STABILITY, AND LOAD-CARRYING [Cont'd] S/779/62/000/008/003/006

and the stabilizing effect of internal pressure in case of asymmetrical buckling is mentioned. An attempt is made to determine the load-carrying capacity of real stiffened and corrugated cylindrical shells having axisymmetrical or asymmetrical initial deformations, and a numerical example for both cases of initial deformation is presented. The use of statistical methods in the further development of determining the load-carrying capacity of shells is outlined briefly. [VK]

Card 2/2

PEN'KOV, A.M., prof.; KAN, S.N., doktor tekhn.nauk, prof., inzhener-polkovnik;
LIVSHITS, Ya.D., doktor tekhn.nauk, prof.

"Structural mechanics for airplanes" by A.A.Umanskii. Reviewed by A.M.Pen'kov, S.N.Kan, IA.D.Livshits. Izv.vys.ucheb.zav.; av.tekh. 5 no.3:187-189 '62. (MIRA 15:9)

1. Chlen-korrespondent AN UkrSSR (for Pen'kov).
(Airplanes—Design and construction)
(Umanskii, A.A.)

S/879/62/000/000/069/088
D234/D308

AUTHOR: Kan, S. N. (Khar'kov)

TITLE: Stability, static and dynamic strength of circular cylindrical three-layer shells

SOURCE: Teoriya plastin i obolochek: trudy II Vsesoyuznoy konferentsii, L'vov, 15-21 sentyabrya 1961 g. Kiev, Izd-vo AN USSR, 1962, 391-393

TEXT: An abstract of an unpublished paper. The author claims to have found a unified method for the design of shells under many different conditions, based on Hooke's law and hypotheses, assuming no displacements of the middle surface and no extension of the shell in the circumferential direction. No equations are given.

Card 1/1

AM4007943 BOOK EXPLOITATION S/

Bel'skiy, Vladimir Leonidovich; Vlasov, Ivan Petrovich; Zaytsev, Valentin Nikolayevich; Kan, Saveliy Nakhimovich (Doctor of Technical Sciences, Professor); Karnozhitskiy, Vladimir Pavlovich; Kots, Veniamin Markovich; Lipovskiy, David Yevseyevich

Aircraft design (Konstruktsiya letatel'nykh apparatov) Moscow, Oborongiz, 1963. 708 p. illus., biblio. Errata slip inserted. 6200 copies printed.

TOPIC TAGS: aircraft construction, aircraft strength, aircraft design, aircraft rigidity, aircraft hydraulics, aircraft pneumatics, aircraft servo, aircraft service life, aeroelasticity, aerodynamic heating

PURPOSE AND COVERAGE: The book is intended for aeronautical engineers concerned with aircaft design and manufacture. It may also be useful to students of technical schools of higher education. The principles of aircraft construction and strength are discussed. The principles of arrangement are examined, and design methods for strength and rigidity are given. External design loads are analyzed, and other

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AM4007943

problems in the construction of airplanes, rockets, and helicopters are examined. The pneumatic and hydraulic aircraft systems as well as hydraulic servos are described. Considerable attention is paid to the problems of aeroelasticity, service life, and aerodynamic heating. The factual and numerical data and the schematic diagrams of aircraft are taken from non-Soviet sources. The authors thank K. A. Ly"nshinsky for writing article 3 of Ch. 2 and N. M. Mitrofanov who particpated in selection of material for some chapters. Special appreciation is expressed to A. M. Okulov for illustrating the book and to Doctors of Technical Sciences A. R. Bonin and Professor L. P. Ninokurov, and Candidates of Technical Sciences N. G. Savusya, L. A. Kolesnikov, A. A. Yarkho and V. P. Rusanov for their valuable suggestions during the review and revision of the manuscript.

TABLE OF CONTENTS [Abridged]:

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KAN, S.N.

AID Nr. 967-13 15 May

COMBINED COMPRESSION AND FLEXURE OF STIFFENED CIRCULAR CYLINDRICAL SHELLS (USSR)

Kan, S. N., and D. Ye. Lipovskiy. Izvestiya vysshikh uchebnykh zavedeniy. Aviatsionnaya tekhnika, no. 1, 1963, 33-47. S/147/63/000/001/005/020

The states of stress and strain of circular cylindrical shells stiffened by stringers and rings are analyzed. The shells are subjected to transversal loading combined with axial compression uniformly distributed along the faces. The effect of manufacturing imperfections of the shell's middle surface is taken into account. The problem is discussed in a linear formulation under conventional assumptions of the theory of elastic thin shells. For solution of this statically indeterminate problem, Kan's method, employing energy principles and structural-mechanics techniques, is used. The axially symmetrical and asymmetrical states of stress (caused by axisymmetrical and arbitrary loading, respectively) are investigated, and formulas for the critical (buckling) load, radial displacements, bending moments, and longitudinal and circumferential stresses are derived. The behavior of shells under arbitrary

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AID Nr 967-13 15 May

COMBINED COMPRESSION [Cont'd] S/147/63/000/001/005/020

loadi g is shown in diagrams for various rigidity parameters. A numerical samp.e calculation is presented of a simply supported stiffened shell under combined uniform continuous loading consisting of axial compression on the faces and a downward vertical load on the inner side along the bottom generatrix. Nondimensional stresses relative to their critical values are calculated in the axial and circumferential directions, and their distribution in cross sections is shown in diagrams for length-to-radius ratios of 5 and 10. The effect of manufacturing irregularities on the shell's stress-strain state and the behavior of the stiffeners are also discussed. [VK]

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L 13805-63 EWP(r)/FCS(f)/BDS/EWT(m) AFFTC/APGC EM

ACCESSION NR: AP3004719 S/0147/63/000/002/0034/0043

34

AUTHOR: Kan, S. N.; Lipovskiy, D. Ye.

TITLE: The load-carrying capacity of stiffened thin circular cylindrical shells under compression

SOURCE: IVUZ. Aviats. tekhnika, no. 2, 1963, 34-43

TOPIC TAGS: load-carrying capacity, compressed cylindrical shell, stiffened shell, thin shell, shell, critical stress, crushing load, initial deflection, manufacturing imperfection

ABSTRACT: The article, which is the conclusion of the work of the authors published in IVUZ, "Aviatsionnaya tekhnika," No. 4, 1962, and No. 1, 1963, presents a simple method for predicting the load-carrying capacity of a thin, compressed, circular cylindrical shell stiffened by a system of frames and stringers and discusses the effect of constructional parameters on the shell's capacity. The method is based on the assumption that the most essential factor reducing the load-carrying capacity of the shell is the manufacturing imperfection (initial deflection), which causes the stringers of a shell under axial compression to be subjected to a combination of compression and transverse flexure. The cases

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L 13805-63

ACCESSION NR: AP3004719

of axially symmetrical and asymmetrical initial deflection are discussed, and the formulas for critical (crushing) stresses for stringers are derived. The effect of the internal pressure and of the rigidity of frames on the magnitude of the critical stresses is analyzed. Illustrative numerical calculations of the critical stresses and crushing load of a shell are given for both symmetrical and non-symmetrical cases. The possibility of extending the application of the proposed method to the case of lateral loading, which is equivalent to a certain initial deflection, and to other types of deformation (bending, combined compression and bending) of shells is mentioned. Orig. art. has: 2 figures and 21 formulas.

ASSOCIATION: none

SUBMITTED: 19Mar62 DATE ACQ: 06Sep63 ENCL: 00

SUB CODE: AP NO REF SOV: 005 OTHER: 005

Card 2/2

KAN, S.N. (Khar'kov)

Stability of circular cylindrical shells under compression.
Stroi. mekh. i rasch. sooruzh. 5 no.6:31-34 '63 (MIRA 17:7)

KAN, S.N.; KIPOVSKIY, D.Ye.

Carrying capacity of framed thin-walled circular cylindrical shells subjected to compression. Izv. vys. ucheb. zav.; av. tekh. 6 no.2:34-43 '63. (MIRA 16:8)

(Elastic plates and shells)

KAN, S.N.

Carrying capacity of circular cylindrical shells subjected to bending. Izv. vys. ucheb. zav.; av. tekh. 6 no.4:63-69 '63. (MIRA 17:8)

ACCESSION NR: AP3005542 S/0198/63/009/004/0356/0366

AUTHOR: Kan, S. N.

TITLE: The stability of framed and corrugated cylindrical shells

SOURCE: Pry*kladna mekhanika, v. 9, no. 4, 1963, 356-366

TOPIC TAGS: stability, cylindrical shell, orthotropic shell, critical force, rigidity

ABSTRACT: The author gives a general procedure for solving the problem of stability of shells both within and beyond the limits of proportionality. The author derives equations for critical tension σ_{cr} and radial stress p_{cr} in each case.

within the limits of proportionality:

$$\sigma_{cr} = \frac{n^2-1}{n^2+1}\sqrt{4\frac{ED_F}{R^2\delta_s}\left(1+\frac{D_s n^4}{ER^2\delta_s}\right)\left(1-p_{cr}\frac{R^3}{D_F(n^2-1)}\right)} \qquad (12)$$

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ACCESSION NR: AP3005542

$$P_{cr}=\frac{D_f\frac{(n^2-1)}{R^3}}{1+0.5\frac{\pi^2R^2(n^2+1)}{L^2n^2(n^2-1)}}\left[1+\frac{\pi^4R^6E\delta_s}{L^4D_f n^4(n^2-1)^2}+\frac{\pi^4R^4D_s}{L^4D_f(n^2-1)^2}\right] \qquad (14)$$

beyond the limits of proportionality:

$$\sigma_{cr}=\sqrt{4\frac{ED_f}{R^2\delta_s}\eta_x\eta_\varphi\left(1+\frac{D_s n^4}{ER^2\delta_s}\right)\left(1-P_{cr}\frac{R^3}{D_f(n^2-1)\eta_\varphi}\right)} \qquad (21)$$

$$P_{cr}=\frac{D_f\frac{(n^2-1)}{R^3}}{1+0.5\frac{\pi^2R^2(n^2+1)}{L^2n^2(n^2-1)}}\left[\eta_\varphi+\frac{\pi^4R^6E\delta_s\eta_x}{L^4D_f n^4(n^2-1)^2}+\frac{\pi^4R^4D_s\eta_x}{L^4D_f(n^2-1)^2}\right] \qquad (23)$$

The author notes peculiarities in calculating constructively orthotropic shells, connected with the determination of dissimilar rigidity characteristics of the system of elements in various directions. The replacement of the true aggregate

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ACCESSION NR: AP3005542

of elements of a constructively orthotropic shell seems to be "smudged" by stringers, frames, or corrugations.

The author presents calculational relationships for the determination of critical forces and gives recommendations for their utilization.

Numerical examples are given of the determination of critical stresses and forces for framed and corrugated shells. (Orig. art. has 25 equations and 4 figures).

ASSOCIATION: Kharkivs'ke vy*shche inzhenerne aviatsiyne uchy*ly*shche (Kharkov Higher Aircraft Engineering School)

SUBMITTED: 24Jul62 DATE ACQ: 20Aug63 ENCL: 00

SUB CODE: PH NO REF SOV: 000 OTHER: 000

KAN, S.N. (Khar'kov)

Carrying capacity of framed and corrugated circular cylindrical shells subjected to compression. Prykl.mekh. 9 no.5:465-472 '63. (MIRA 16:10)

1. Khar'kovskoye vyssheye inzhenernoye aviatsionnoye uchilishche.

ACCESSION NR: AT4039433 S/2879/64/000/000/0489/0494

AUTHOR: Kan, S. N. (Khar'kov)

TITLE: The carrying capacity of circular cylindrical shells under compression

SOURCE: Vsesoyuznaya konferentsiya po teorii obolochek i plastin. 4th, Yerevan, 1962. Teoriya obolochek i plastin (Theory of plates and films); trudy* konferentsii, 1964, 489-494

TOPIC TAGS: shell, cylindrical shell, circular cylindrical shell, yield point, compression, compressive load, carrying capacity, shell stability, critical stress, buckling moment, flexion.

ABSTRACT: Noting that the loss of carrying capacity by a shell may be the result of either the loss of stability or the breakdown of strength, the author points out that there is no consensus with respect to the mechanism whereby the loss of shell stability occurs. The author rejects the nonlinear approach to the determination of critical shell stresses with allowance for considerable radial displacements on the part of system elements, and advances the belief that it is physically more convincing, as well as mathematically correct, to determine shell carrying capacity from linear positions while at the same time taking

ACCESSION NR: AT4039433

into account the small initial bends of the surface. The entire aggregate of irregularities in the center surface of the system may be divided into two groups: those which correspond to a stability loss in axiosymmetrical form and those which do so in nonaxiosymmetrical form. Under the influence of external forces of compression the individual longitudinal elements of the shell are found in a state of longitudinal-transverse flexure. All other conditions being equal, the axiosymmetrical form of initial bending is the most dangerous. Thus, the carrying capacity of the shell may be determined from the strength condition by those external forces of compression, from which the sum internal stresses may reach the yield point of the material. It is noted, however, that this order of calculation will agree with experimental data only in the event that the values of the radius-to-thickness ratio (R/δ) of the shell are relatively small. In his analysis of what takes place in the case of large R/δ, the author advances the theory that the buckling moments of the individual bands, with longitudinal-transverse flexure, may be considered the consequence not of the real initial axiosymmetrical bending of the surface, but of an equivalent imaginary axiosymmetrical load, from which the shell loses stability in non-axiosymmetrical form. Since the flexional rigidity of the shell elements is proportional to the cube of its thickness, then, in the case of relatively large R/δ (that is, in the case of small thickness parameters)

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shell stability loss is extremely probable, with the compressing external axial load actively promoting this phenomenon. On the basis of these phenomena, the author derives the calculation formulas for shell carrying capacity. The crippling axial stress, corresponding to a non-axiosymmetrical form of stability loss, with allowance for the effect of the constant radial load p, is found to be

$$\sigma_x = \sigma_{cr} \sqrt{1 - \frac{pR^3}{D(n^2 - 1)}}, \tag{1}$$

where n is the whole number of waves in the circumferential direction generated at the time of the stability loss from the joint effect of the axial forces and radial pressure. The necessary minimum value n must correspond to the whole number of halfwaves m along the generatrix, as expressed by the following formula:

$$\left(\frac{m\pi R}{nL}\right)^4 = \frac{D(n^2 - 1)^2}{R^2 E\delta}\left[1 - \frac{pR^3}{D(n^2 - 1)}\right]. \tag{2}$$

The author arrives at

$$\sigma_x = \sqrt{1 - \frac{ER}{D(n^2 - 1)} \frac{2f_0 \delta \sigma_x}{(1 - \sigma_x)}} \tag{3}$$

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or

$$\frac{(1-\bar{\sigma}_x^2)(1-\bar{\sigma}_x)}{\bar{\sigma}_x}=\frac{24(1-\mu^2)}{(n^2-1)}\frac{R}{\delta}\bar{f}_0, \quad (4)$$

where

$$\bar{f}_0=\frac{f_0}{\delta} \quad (5)$$

and μ is the Poisson coefficient. An analysis of the calculation formula for $\bar{\sigma}_x$ shows that the relative value of the carrying capacity $\bar{\sigma}_x$ depends on the initial irregularities f_0. If the technology employed in the manufacture of the piece is high ($\bar{f}_0$ approaching zero), then σ_x will approach σ_{cr}. Further, it is important to note the substantial effect of R/δ on the value of $\bar{\sigma}_x$. As R/δ increases, $\bar{\sigma}_x$ falls, which is in complete agreement with experimental work with shells. The practical use of these formulas in a specific structural manufacturing technology is explained in the article. The graphic physical nature of this method, the simplicity of the derivation of the engineering formulas and plotting of the shell strength and stability curves, as well as its practically total agreement with the results both of experimentation and computations on the basis of the complex methodology proposed by other authors (Donnell among them) - all speak in

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ACCESSION NR: AT4039433

favor of the solution presented in this paper. Also, this method for calculating carrying capacity considers transverse loads, which may sharply reduce the carrying capacity of a shell in those cases in which the initial bending, equivalent to it, approaches the "critical" harmonic. At the same time, it is obvious that large local depressions may have some small effect on the carrying capacity if they are irregular in character and, consequently, when expanded into a Fourier series, have very small amplitudes for the harmonic adjacent to the "critical". Orig. art. has: 14 formulas and 1 figure.

ASSOCIATION: none

SUBMITTED: 00 DATE ACQ: 14May64 ENCL: 00

SUB CODE: AS NO REF SOV: 002 OTHER: 000

ACCESSION NR: AT4044287 S/2779/64/000/009/0161/0186

AUTHOR: Kan, S. N., (Professor, Doctor of Technical Sciences;Khar'kov); Antonenko, E. V., (Engineer; Khar'kov)

TITLE: Bending of circular cylindrical shells

SOURCE: Raschet prostranstvenny*kh konstruktsiy; sbornik statey, no. 9, 1964, 161-186

TOPIC TAGS: thin walled shell, shell design, bending stress, cylindrical shell, circular cylindrical shell, rigid diaphragm

ABSTRACT: Earlier publications by S. N. Kan and A. G. Immerman have considered bending of orthotropic structural thin-walled circular cylinders with separate rigid diaphragms. The same method may be used for systems with separate elastic circular ribs. In the present paper, the authors derive curves for finding the stresses in basic sections under various boundary conditions, as well as equations for the stresses at fixed ends and at the ribs. The shell stresses were determined by the variation (energy) method. The stressed state of a thin-walled beam with unstrained cross section is taken as the basis of the calculations (see the Enclosure). The longitudinal normal stresses are then given by:

$$\sigma_{x_0} = \frac{M_{ax}}{J_z} y; \qquad (1)$$

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and the oblique forces by: $q_0 = \tau_0 \delta = \frac{Q_y S_z}{J_z}$. Bending moments ($m\,Q_0$), lateral and ($Q\,Q_0$) and annular normal forces ($N\,Q_0$) are obtained by considering elementary rings cut every 1 cm. The total moments are then found by using series. The unknown coefficients for the derivation of the function of x are found by solving a simple variation problem for the minimum potential strain energy. Curves are included in the paper showing the variation in the function of x and its derivatives in the basic sections depending on the structural parameters, which alter the dimensionless value:

$$k_n L = \frac{L}{R} \sqrt[4]{\frac{n^4 (n^2 - 1)^2 D_m}{4R^2 E h_c}} \qquad (3)$$

The added moments taken as functional unknowns are:

$$\begin{aligned} m_\varphi &= m_{\varphi_0} + m_{\varphi_{\text{доп}}} = \sum_{n=2}^{\infty} \psi_{n_0} \cos n\varphi + \sum_{n=2}^{\infty} \psi_{n_{\text{доп}}} \cos n\varphi = \\ &= \sum_{n=2}^{\infty} (\psi_{n_0} + \psi_{n_0} \bar{\psi}_{n_{\text{доп}}}) \cos \varphi = \sum_{n=2}^{\infty} \psi_n(x) \cos n\varphi, \end{aligned} \qquad (4)$$

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ACCESSION NR: AT4044287

Bending is found only at a certain distance from the ribs. The additional normal stress at a fixed end is given by:

$$\sigma_{x_{\text{доп}}} = -\frac{ER^{3}}{D_{\text{ш}}}\sum_{n=2}^{\infty}\frac{\psi_n^{\bullet}(x)}{n^{2}(n^{2}-1)}\cos n\varphi = -\frac{ER^{3}}{D_{\text{ш}}}\sum_{n=2}^{\infty}\frac{k_n^{2}\psi_{n_0}}{n^{2}(n^{2}-1)}\bar{\psi}_n^{\bullet}\cos n\varphi; \tag{5}$$

This may be changed into a series:

$$\sigma_{x_{\text{доп}}} = -\sqrt{\frac{E}{\delta_c D_{\text{ш}}}}\left[m_{\varphi_0} - \frac{1}{\bar{\psi}_{n\infty}^{\bullet}}\sum_{n=2}^{\infty}(\bar{\psi}_{n\infty}^{\bullet} - \bar{\psi}_n^{\bullet})\psi_{n_0}\cos n\varphi\right]\frac{1}{\chi}\bar{\psi}_{n\infty}^{\bullet}. \tag{6}$$

The additional tangential forces at a fixed end or rib are given by:

$$q_{\text{доп}} = \frac{ER^{4}\delta_c}{D_{\text{ш}}}\sum_{n=2}^{\infty}\frac{\psi_n^{\bullet\bullet}(x)}{n^{3}(n^{2}-1)}\sin n\varphi = \frac{ER^{4}\delta_c}{D_{\text{ш}}}\sum_{n=2}^{\infty}\frac{k_n^{3}\psi_{n_0}}{n^{3}(n^{2}-1)}\bar{\psi}_n^{\bullet}\sin n\varphi; \tag{7}$$

$$q_{\text{доп}} = -\sqrt{\frac{R}{8}}\sqrt[4]{\frac{E\delta_c}{D_{\text{ш}}}}\left[Q_{\varphi_0}\bar{\psi}_{n\infty}^{\bullet} + \frac{1}{R}\sum_{n=2}^{\infty}n\psi_{n_0}\times\right. \tag{8}$$

$$\left.\times\left(\bar{\psi}_{n\infty}^{\bullet} - \frac{\sqrt{n^{2}-1}}{n}\bar{\psi}_n^{\bullet}\right)\sin n\varphi\right].$$

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ACCESSION NR: AT4044287

The additional bending moments in structural sections at fixed ends are:

$$m_{s_{\text{зак}}} = -\frac{D_c}{D_m}\sum_{n=2}^{\infty}\frac{R^2}{n^2-1}\psi_n^{\cdot}(x)\cos n\varphi = -\frac{D_c R^2}{D_m}\sum_{n=2}^{\infty}\frac{k_n^2\psi_{n_0}}{(n^2-1)}\bar{\psi}_n^{\cdot}\cos n\varphi \tag{9}$$

or

$$m_{s_{\text{зак}}} = \frac{D_c}{2D_m}\sqrt{\frac{D_m}{Eh_c}}\left[N_{n_0}\psi_{n_0}^{\cdot} + \sum_{n=2}^{\infty}\frac{n^2}{R}\psi_{n_0}(\bar{\psi}_{n_0}^{\cdot} - \bar{\psi}_n^{\cdot})\cos n\varphi\right]. \tag{10}$$

An example is given in the paper of pipeline design using numerical values, as well as a numerical example of water tower design. "Candidate of technical sciences, docent P. A. Shkor'ny*y, Candidate of technical sciences Yu. I. Kaplan and Engineer S. S. Kan took part in the investigations connected with deriving the formulas." Orig. art. has: 21 figures, 11 tables and numerous equations.

ASSOCIATION: none

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ACCESSION NR: AT4044287

SUBMITTED: 00

ENCL: 01

SUB CODE: AS

NO REF SOV: 005

OTHER: 000

Card 5/6

ACCESSION NR: AT4044287

ENCLOSURE: 01

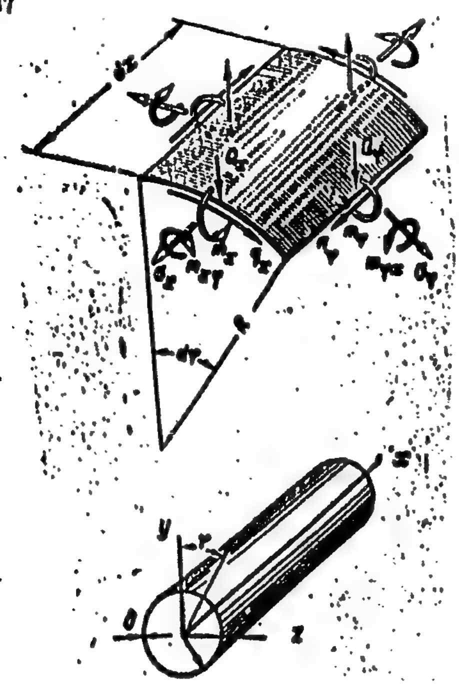

Figure 1.

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L 00770-67 EWP(k)/EWT(d)/EWT(m)/EWP(w)/EWP(v)/EWP(t)/ETI IJP(c) EM/WW/JD/HW

ACC NR: AT6022504 SOURCE CODE: UR/2779/65/000/010/0119/0126

AUTHOR: Kan, S. N. (Doctor of technical sciences; Professor; Kharkov) 37

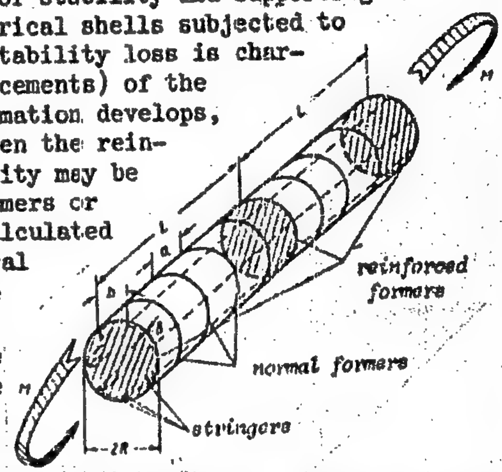
ORG: None B+1

TITLE: Stability of a circular cylindrical shell under bending and twisting

SOURCE: Raschet prostranstvennykh konstruktsiy; sbornik statey, no. 10, 1965, 119-126

TOPIC TAGS: shell theory, shell structure stability, cylindric shell structure, BENDING STRESS

ABSTRACT: The author considers the overall loss of stability and supporting power of structurally orthotropic circular cylindrical shells subjected to bending and twisting (see figure). The overall stability loss is characterized by simultaneous twisting (radial displacements) of the sheeting, stringers and normal formers. As deformation develops, dents are formed in the shell in the span L between the reinforced formers. The cause of structural instability may be insufficient bending resistance in the normal formers or stringers. The critical loads are most easily calculated by the energy method assuming conditions of neutral equilibrium. The rigidity characteristics of the system are given and loss of stability is calculated under pure bending and under twisting. The effect of initial deviations from the ideal shape is considered. An example is given showing ap-



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L 00770-67

ACC NR: AT6022504

plication of the proposed method for calculating the axial breaking load and the bending and twisting moments in a specific orthotropic shell. Orig. art. has: 3 figures, 15 formulas.

SUB CODE: 20/ SUBM DATE: none

Card 2/2

ACC NR: AM6027258 Monograph UR/

Kan, Saveliy Nakhimovich

Structural mechanics of shells (Stroitel'naya mekhanika obolochek) Moscow, Izd-vo "Mashinostroyeniye," 1966, 507 p. illus., biblio. 6000 copies printed.

TOPIC TAGS: ~~shell~~, thin wall shell, shell strength, shell design, ~~shell design calculation~~, ~~shell calculation method~~, shell structure, shell vibration, shell structure stability, shell structure dynamics

PURPOSE AND COVERAGE: This book is intended for design-engineers of the aviation industry and other branches of machine-building. It may also be useful to students and aspirants of schools of higher education. The book reviews methods of calculating the strength, stability and vibration of thin-wall shells used in various branches of machine-building and construction shells with a curvilinear axis and shells of various geometry are also discussed and the effect of various stresses and deformation is analyzed. The rectangular and round plates of shells are also outlined. Calculations are based on a particularly effective single energy method which can be applied over a wide range of engineering specialties. For better understanding of this method, examples of shell calculation based on hypothetical data are presented. The author

Card 1/3 UDC: 62—215:539.4:534-9.014.1:624:04

ACC NR: AM6027258

expresses his thanks to D. Ye. Lipovskiy, A. V. Silantyev, Yu. I. Kaplan, I. A. Troporeva, K. Ye. Bursan, A. Ye. Polyektov and S. S. Kan for their assistance.

TABLE OF CONTENTS [abridged]:

ACC NR: AM6027258

SUB CODE: 20/ SUBM DATE: 25Feb66/ ORIG REF: 045

Card 3/3

L 29417-66 EWP(k)/EWT(d)/EWT(m)/EWP(w)/EWP(v) IJP(c) EM/WW
ACC NR: AR5020405 SOURCE CODE: UR/0124/65/000/008/V016/V016

41
B

AUTHOR: Shkol'nyy, P. A.; Kan, S. S.

TITLE: Studies of the state of stress of a cylindrical graduation-shell with various boundary conditions

SOURCE: Ref. zh. Mekhanika, Abs. 8V111

REF SOURCE: Sb. Zhelezobeton. konstruktsii. Vyp. 2(31). Khar'kov, Khar'kovsk. un-t, 1964, 72-82

TOPIC TAGS: stress analysis, mechanical stress, stress distribution, cylindric shell structure

ABSTRACT: A determination was made of the stresses in a closed orthotropic, thin, resilient, circular, cylindrical shell with a non-axially-symmetrical load. It was proposed to determine the stress in the shell as a sum of the stresses in the basic and complemental systems. Considered to be the basic system is the thin-walled beam with a non-deformable contour; the complemental system takes into account forces of interaction between individual rings and between the diaphragm and the shell. The unknown stresses are introduced in

L 29417-66

ACC NR: AR5020405

0

series, whose convergence is shown by means of computations. Computation graphs and examples are given. V. Ye. Breslavskiy

SUB CODE: 20/ SUBM DATE: none

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L 16165-66 EWT(d)/EWT(m)/EWP(w)/EWP(v)/EWP(k)/EWA(h)/ETC(m)-6 IJP(c)
ACC NR: AP6007547 WW/EM SOURCE CODE: UR/0198/66/002/001/0059/0068

AUTHOR: Kan, S. S. (Khar'kov) 32 B

ORG: Khar'kov Institute of Civil Engineering (Khar'kovskiy inzhenernostroitel'ny institut)

TITLE: Buckling of axially compressed shells of revolution with curvilinear generatrices 26

SOURCE: Prikladnaya mekhanika, v. 2, no. 1, 1966, 59-68

TOPIC TAGS: shell, shell of revolution, shell buckling, buckling stress, axially compressed shell

ABSTRACT: The buckling of shells of revolution having curvilinear generatrices of arbitrary shape and subjected to axial compression is investigated. The energy method is applied to solving the problem, and the basic partial differential equations of the general theory of the local stability of shells are used. It is assumed that the shell was membrane-stressed prior to buckling, that the radial displacements are larger than the meridional ones, that the shell is inexpandable along the parallels, and that there are no detrusions in the middle sur-

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ACC NR: AP6007547

face of the shell. The nonaxisymmetric and axisymmetric modes of buckling of shells with positive and negative Gaussian curvatures are examined, formulas for determining the minimal buckling force are derived, and qualitatively new conclusions are drawn concerning the effects of the curvature (especially of the negative) on the magnitude of the buckling force. These effects due to the presence of flexure, combined with compression, are illustrated by a sample calculation of the buckling force for a shell having a shape only slightly deviating from a cylinder. It is shown that even such a small curvature can reduce the buckling stress to a fraction of its magnitude determined for a cylindrical shell of same dimensions. It is concluded that the buckling-stress formulas derived for cylindrical shells under axial compression cannot be used in analyses of shells of revolution with a generatrix even slightly deviating from a straight line. Orig. art. has: 2 figures and 15 formulas. [VK]

SUB CODE: 20/ SUBM DATE: 17Jun65/ ORIG REF: 006/ ATD PRESS: 4204

L 20675-66 EWT(d)/EWT(m)/EWP(w)/EWP(v)/EWP(k)/EWA(h)/ETC(m)-6 IJP(c) WW/EM

ACC NR: AP6007565 SOURCE CODE: UR/0198/66/002/002/0036/0043

AUTHOR: Kan, S. S. (Khar'kov)

33

ORG: Khar'kov Civil Engineering Institute (Khar'kovskiy inzhenerno-straitel'nyy institut)

32

13

TITLE: Stability of shells of revolution with a generator of arbitrary curvature

SOURCE: Prikladnaya mekhanika, v. 2, no. 2, 1966, 36-43

TOPIC TAGS: shell of revolution, shell stability, shell buckling, spheroid shell

ABSTRACT: The investigation presented is a continuation of the author's work reported in ATD Press, v. 4, no. 204, 13 Apr 66, 5-6. The buckling behavior of shells of revolution with arbitrarily large curvature of the generator, under axial compression and radial pressure, is analyzed by using the energy method. An expression for the critical (buckling) compression force P_{cr} is derived, and it is shown that the expression for P_{cr} previously derived for shells of revolution with small curvature can be used for shells with large curvature by changing the shell parameters accordingly. The known formulas for the buckling force for plain cylindrical 26 and conical shells can easily be deduced from these general expressions. The axially symmetrical and asymmetrical buckling of conical shells 26 is analyzed in this way. The buckling of isotropic shells of revolution generated by revolving a closed curve about its axis of symmetry, subjected to external radial pressure p, is investigated; an expression for determining the external buckling pressure P_{cr} is

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L 20675-66

ACC NR: AP6007565

derived. The buckling of ellipsoids of revolution generated by revolving an ellipse about its major and minor axes, and formulas for the buckling pressure of these types of spheroids 26 are deduced. The buckling of a spheroid under internal pressure is also discussed, and a formula for the internal buckling pressure is given. Orig. art. has: 5 figures and 19 formulas. [VK]

SUB CODE: 20/ SUBM DATE: 21Jun65/ ORIG REF: 007/ ATD PRESS: 4223

Card 2/2 BK

69851

SOV/35-59-9-6942

3.1410

Translation from: Referativnyy zhurnal, Astronomiya i Geodeziya, 1959, Nr 9, p 10 (USSR)

AUTHOR: Kan, Sh.U.

TITLE: Comet 1951 X Arend

PERIODICAL: Byul. In-ta teor. astron. AS USSR, 1959, Vol 17, Nr 3, pp 208 - 220 (Engl. résumé)

ABSTRACT: The final orbit of the 1951 X Arend comet has been determined from 41 observations carried out from October 1, 1951 to April 24, 1952. The perturbations from five planets have been taken into consideration (Venus - Saturn). The mean error for one normal coordinate is $\sigma = \pm 1''.50$. The calculation of the perturbations is continued for the next revolution of the comet and the ephemeris of the comet is given for the period from July 21, to December 28, 1959. The following systems of the elements were obtained:

0^h ephemerides time.	1951 November 10.0		1959 August 20.0	
T ephemerides time.	1951 November 23. 42 307		1959 September 2. 46 552	
ω	$44^\circ 29' 38''.37$	1950.0	$44^\circ 36' 02''$	1950.0
Ω	$357^\circ 41' 39''.87$		$357^\circ 36' 30''$	
i	$21^\circ 42' 1''.30$		$21^\circ 38' 58''$	

Car

Card 1/2

KAN, Sh. U., Cand Phys-Math Sci (diss) -- "Precalculation of the appearance of the comet 1951 X Arend". Leningrad, 1960. 9 pp (Acad Sci USSR, Main Astron Observatory), 200 copies (KL, No 12, 1960, 124)

KAN, Sh.U.

Identity of Arend's comet (1951 X)with other comets. Biul. Inst.teor.astron. 8 no.3:240-241 '61. (MIRA 14:11)
(Comets--1951)

TIKHONOV, V.Ya., kand. tekhn. nauk; KAN. Sh.U., kand. fiziko-matem. nauk; BYR'KA, V.F., kand. tekhn. nauk

Transient process in an automatic-control stepped-relay system during multiple successive controller firing. Izv. vys. ucheb. zav.; gor. zhur. 6 no.9:172-181 '63. (MIRA 17:1)

1. Karagandinskiy politekhnicheskiy institut (for Tikhonov, Kan).
2. Karagandinskiy nauchno-issledovatel'skiy ugol'nyy institut (for Byr'ka).

23063

9.7140 (1164)

S/200/61/000/005/001/002
D227/D303

AUTHORS: Kirenskiy, L. V., Buravikhin, V. A., Kan, S. V., and Degtyarev, I. F.

TITLE: Domain structure of thin ferromagnetic films

PERIODICAL: Akademiya nauk SSSR. Sibirskoye otdeleniye. Izvestiya, no. 5, 1961, 3-9

TEXT: In recent years, a series of theoretical and experimental investigations have been carried out on the domain structures and the structures of domain shells in thin ferro-magnetic films by T. Kaczer (Ref. 4: K Doménove strukturé tenkých ferromagnetyckych vrstev, československý časopis pro fysiku, 7, 516 (1957), I. N. Shklyarevskiy (Ref. 18: K voprosu ob izmerenii tolshchin tonkikh plenok s pomoshch'yu liniy ravnogo khromaticheskogo poryadka, t. "Optika i Spektroskopiya", 5, 617 (1958), L. V. Kirenskiy, I. F. Degtyarev (Ref. 19: O temperaturnoy ustoychivosti domennoy struktury v kristallakh kremnistogo zheleza, ZhETF., 35,

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S/200/61/000/005/001/002
D227/D303

Domain structure...

3, (9), 584 (1958)), R. M. Moon (Ref. 15: Internal structure of cross-tied walls in thin Permalloy films through high-resolution Bitter techniques, j. Appl. Phys., 30, 82, 1959), I. B. Gomi, Y. Odani (Ref. 16: Chain wall in Permalloy Thin Films, j. of the Physical society of Japan, 15, 3, 535, 1960) and C. E. Fuller (Ref. 17: Domains patterns and reversals by wall movements of thin films of iron and nickel iron, j. Phys., et radium, 20, No. 2-3, 310, 1959). The study of thin films opens up the possibility of applying known microscopic methods of investigation in the study of microscopic properties of matter. Investigation of ferro-magnetic properties of thin films could be useful in clarifying problems of ferro-magnetic theory and here provide useful data for massive ferro-magnetic samples. Detailed study of space distribution of self-magnetism in thin ferro-magnetic films appears an important stage on the way to developing the theory of technical magnetization. The practical study of the

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Domain structure...

properties of thin ferro-magnetic films could lead to perfecting the "memory" elements of modern computers. Mainly due to their comparatively simple production and better rate of demagnetization they have important advantages over ferrite cores in computers. The study of the configuration of the domain structure of ferro-magnetic films and its dependability on the technology of preparation, chemical composition and thickness, and also the change of domain structure in the magnetic field, could provide the best choice of "memory" elements of computers and electronic machines. Missing from most of the work already done in the study of domain structure of thin ferro-magnetic films, is the effect of technology of film preparation, film thickness on the configuration of domain structure and also film changes in the process of magnetization and demagnetization. The present work deals with the effect of the technology of preparation and thickness of the film of alloy consisting of 80% nickel, 17% iron, and 3% molybdenum on the configuration of their domain

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structure as well as the change in film domain structure of this alloy and also of the alloy containing 50% nickel, 50% iron in the magnetic field. To prepare ferromagnetic films a vacuum device was used, whose diffusion pump yields a vacuum aggregate VA-05-1. Films were obtained by melting the above-mentioned alloys in a tungsten crucible and developing films on optically polished glass having the form of a rectangle of 10 x 40 mm, 8 x 36 mm, and also on discs of 2 to 8 mm diameter. The films were placed in a magnetic field produced by a pair of Helmholtz coils. The direction of the field was in the plane of the films. The films of alloy Fe-Ni-Mo were prepared as follows: (a) Base temperature of 350°C., in a magnetic field of 125, 100, 75, 50, 25 and 4 oersteds; (b) Base temperature 420, 350, 150 and 50°C., in a field of 100 oersteds; (c) The films of alloy Fe-Ni-Mo of different thicknesses from 6150 Å to 140 Å, and also films of alloy Fe-Ni were prepared at base temperatures up to 350°C and in a field of 100 oersteds. The films prepared in the magnetic

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field possessed uniform anistrophy along the axis which corresponded to the direction of applied magnetic field. The thicknesses of the films were measured by the universal monochrometer UM-2 by means of the lines of uniform chromatic order. Domain structure was investigated by the method of powder figures with a magnification of 280 on the MBI-6 microscope and also by the method of Kerr's meridian magneto-optical effect as quoted in Ref. 19 (Op. cit.). The powder method enables the study of domain structure at high magnification, the details of boundaries and domains, and it possesses appreciable inertness. Hence for the study of change of domain structure with a rapidly changing field, the non-inert method of Kerr's meridian magneto-optical method is used which unfortunately does not enable study at high magnification. To use this method, the ferro-magnetic film heated to 250°C, was covered in vacuum with a thin dielectric layer of zinc sulphide. This decreases the destructive effect of temperature on the anisotropy of films and during covering

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with sulphide a magnetic field of 70 oersteds was applied parallel to the direction of the field used during the evaporation of metal. The dielectric layer appreciably increases the deflection angle of plane polarized light and this increases the contrast between adjacent domains making visual inspection possible. Subsequent work over three months has not detected any change in the behavior of domains and the zinc sulphide layer. The ferro-magnetic films, prepared on the basis of heating above 200°C possessed a time-stable domain structure, mechanical strength and chemical stability. The domain structure of ferro-magnetic films depends largely on the demagnetization conditions. Increasing the angle between the demagnetizing field and the magnetization axis, the structure becomes very fine, the direction of domain boundaries usually following the magnetization axis. The domain structure also depends on the demagnetization rate of films. The most correct structure is obtained at slow demagnetization; a high demagnetization rate gives large domains and their structures are less con-

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trollable. A decrease in the thickness of ferro-magnetic films gives rise to a tendency to bend the boundaries and to give boundaries with cross connections. The study of the magnetization process indicates that it proceeds as follows: (a) For the thickness (about 500-700 Å) and for dissimilar films, the domains grow along the orientation of the applied field, with clear-cut boundaries; (b) corresponding films with thicknesses greater than 1000 Å change in domain structure, occur along the axis of the magnetizing field and a mixing of boundaries takes place. When magnetizing at an angle of 45°, it could happen that the motion of boundaries does not occur, but inside the poorly oriented domains, the bending of magnetic vectors results, gradually gripping all domains; on the other hand magnetizing at an angle of 90°, the boundary mixing does not take place and magnetic vectors turn smoothly toward the direction of the field. The reverse magnetization process usually starts with clearly defined nuclei, the growth of which is analogous to the magnetization process. There are 9 figures and 19 references: 3 Soviet

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D227/D303

Domain structure...

bloc and 16 non-Soviet-bloc. The references to the English-language publications read as follows: I. By. Gomi, I Odani, Chain wall in Permalloy Thin Films, j. of the Physical society of Japan, 15, 3, 535, 1960; C. E. Fuller, Domains patterns and reversals by wall movements of thin films of iron and nickel iron, j. Phys., et radium, 20, No. 2-3, 310, 1959; M. Prutton, The observation of domain structure in magnetic thin films by means of the Kerr magneto-optia effect, Philos. Mag., 4, No 45, 1063, 1959; and H. W. Fuller, H. Rubinstein, Observations made on domain walls in thin films, j. Appl. Phys., 30, 84, 1959.

ASSOCIATION: Institut fiziki, Sibirskogo otdeleniya AN SSSR gos. Pedinstitut, Krasnoyarsk (Institute of Physics, Siberian Section, AS USSR, State Ped. Institute, Krasnoyarsk)

SUBMITTED: August 12, 1960

Card 8/8

24,3600

25792
S/048/61/025/005/006/024
B104/B201

AUTHORS: Kirenskiy, L. V., Kan, S. V., and Degtyarev, I. F.

TITLE: Study of the magnetic structure of thin ferromagnetic films with the aid of the magnetooptical Kerr effect

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 25, no. 5, 1961, 584-591

TEXT: The present investigation was the subject of a lecture delivered at a symposium on thin ferromagnetic films (Krasnoyarsk, July 4 to 7, 1960). The development of magnetooptical methods for the observation of domain structures is fairly recent (H. J. Williams et al., Phys. Rev., 82, 119 (1951); C. Fowler et al., Phys. Rev., 94, 52 (1954)). M. Prutton (Philos. Mag., 4, 45, 1063 (1959)) has indicated a method and an apparatus for the visual observation of ferromagnetic films. No usable results obtained by this method have been, however, published heretofore. The deficiencies of the magnetic powder methods used for most of the studies in this field are enumerated, and next, the studies conducted by the present authors on the magnetic structure of thin ferromagnetic films,

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using the magnetooptical longitudinal Kerr effect, are described. Nickel alloy films (80% Ni, 17% Fe, 3% Mo) were sputtered in vacuum (10^{-5} mm Hg) onto polished glass backings. The uniaxial magnetic anisotropy while producing the films was brought about by a 100-oe field oriented in the film plane. The glass backings had temperatures up to 350°C. For the visual observation and for photographing the domains a thin dielectric zinc sulfide layer was sputtered at 10^{-5} mm Hg, and a 70-oe magnetic field, being oriented in the same way as the one in the production of the ferromagnetic film, was applied. This layer increased the angle of rotation of the reflected plane-polarized light, whereby the contrast between the domains was augmented. The experimental setup is presented in Fig. 1. The properties of various films studied with this setup were found to differ. The directions of easiest and heavy magnetizing were determined from the domain structure of the specimens, which appeared after the films were demagnetized. When applying a field being perpendicular to the field used in the production of the film, the contrast between the domains dropped with a rise of the field strength, without the domain configuration changing noticeably, or the favorably oriented domains appeared. The authors discuss the effect of demagnetization conditions upon the domain

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Study of the magnetic structure...

structure, and the modification of the domain structure of films during the magnetizing process. To summarize: (1) A very fine domain structure appears on an increase of the angle between the direction of the demagnetizing process and the axis of easiest magnetizing of the films; (2) a structure consisting of coarse domains, differing and undefined in shape, was established in case of a fast demagnetization. A fine domain structure appeared on a slow demagnetization. A study of magnetization indicated that (1) domains grow abruptly on thin (500 - 600 Å) and non-uniform films; (2) on an increase of the film thickness and of the angle between the magnetic field and the direction of easiest magnetizing the domain boundaries are shifted uniformly in case of uniform films. In case of a magnetization in the direction of difficult magnetizing the configuration of the domains does not change, but the contrasts between the domains become weaker and disappear once saturation is attained. The contrast between the domains is restored in part when the field is disconnected; (3) if a field with the direction at 45° is applied, a brightening of dark fields (or a darkening of bright fields) will be observed. There are 7 figures and 7 references: 2 Soviet-bloc and 5 non-Soviet-bloc.

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ASSOCIATION: Institut fiziki Sibirskogo otdeleniya Akademii nauk SSSR (Institute of Physics of the Siberian Department, Academy of Sciences USSR), Krasnoyarskiy gos. pedagogicheskiy institut (Krasnoyarsk State Pedagogical Institute)

Fig. 1

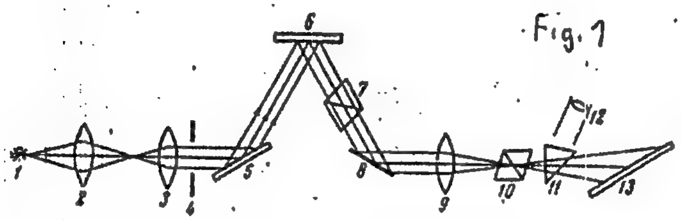

Fig. 1: Scheme of optical arrangement. Legend: 1, light source; 2, condenser; 3, collimator; 4, diaphragm; 5 and 6, mirror; 7, polarizer; 8, specimen; 9, objective; 10, analyzer; 11, prism; 12, observation tube; 13, photographic film.

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24,2200

AUTHORS: Kirenskiy, L. V. and Kan, S. V.

TITLE: Study of the domain structure of thin ferromagnetic films with slow magnetic reversal

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 25, no. 5, 1961, 593-595

TEXT: The present investigation was the subject of a lecture delivered at a symposium on thin ferromagnetic films (Krasnoyarsk, July 4 to 7, 1960). The authors studied the magnetic structure of ferromagnetic films with the aid of the longitudinal Kerr effect in case of a slow magnetic reversal. The possible difference between slow and fast magnetic reversal is pointed out. The production of specimens and investigation methods are described in the present issue (Kirenskiy et al., Izv. Akad. nauk., ser. fiz., v. 25, no. 5, p. 584). The film properties differed very markedly in part because of the effect of factors, not controlled during the preparation of the films, upon the said properties. The quality of the films cannot yet, in the authors' opinion, be fully controlled today

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during production. In addition, the films undergo magnetic reversal depending upon their initial state. Thus, a domain structure was not observed to appear on homogeneous films saturated in very strong fields (up to 500 oersteds), and the magnetic reversal occurred by rotation of the magnetization vector. Magnetic reversal in inhomogeneous fields always began with the formation of nuclei with reverse magnetization. Bright wedge patterns growing jump-like arise at the upper end of a film (580 Å) with the gradual growth of a magnetic field oriented in the direction of easiest magnetizing. These changes are ascribed to inhomogeneities of the film. This state of saturation is conserved when switching off the field, which is convincing evidence of the magnetic reversal depending markedly upon the degree of homogeneity of the film. An entirely different character of transformation was observed in films of thicknesses around 800 Å. If the magnetic field is oriented in the direction of easiest magnetizing, the film as a whole will undergo an abrupt magnetic reversal at a given field strength. The authors had to overcome great difficulties to obtain nuclei with reverse magnetizations. The films had to be well demagnetized for this purpose. If the films were magnetized in very strong fields, a rotation of the magnetization vector

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Study of the domain structure of ...

was observed with a magnetic reversal at an angle of 30-40°. This character of magnetic reversal was observed up to 60-80°. In films up to about 800 Å thick, the domains were, regardless of the angle of magnetic reversal, oriented in the direction of easiest magnetizing. In films about 1100 Å thick both form and contrast between the domains changed with growing angle of magnetic reversal. In case of a slow demagnetization by an alternating field oriented along the axis of easiest magnetizing, a structure consisting of straight and parallel domains appeared. The magnetic reversal along the direction of easiest magnetizing begins at the opposite corners of the film, where wedge-shaped nuclei of a reverse magnetization appear; in addition, domains arise [illegible] displacement of boundaries. To summarize: (1) Inhomogeneous films [illegible] Å thick undergo a magnetic reversal in a wide range of field strengths with small jumps, without a uniform displacement of the domain boundaries becoming visible; (2) homogeneous films 800 Å thick in the direction of easiest magnetizing behave as a single-domain specimen. However, the magnetic reversal with enlarging angle between the magnetization field and the direction of easiest magnetizing takes place by way of the formation of magnetic reversal nuclei and a displacement of the domain boundaries; (3) in all

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films, excepting those 590 Å thick, a slow displacement of boundaries in a constant magnetic field was established; (4) with growing film thickness and enlargement of the angle between the field direction and the direction of easiest magnetizing, an ever more uniform displacement of the boundaries is observed. In addition, the reproducibility of patterns is also found to improve with repeated magnetic reversal. There are 5 figures and 5 references: 1 Soviet-bloc and 4 non-Soviet-bloc. The most important reference to English-language publications reads as follows: Colm R., Mitchell E.N., J. Appl. Phys., 30, 4, 258 (1959).

ASSOCIATION: Institut fiziki Sibirskogo otdeleniya Akademii nauk SSSR (Institute of Physics of the Siberian Department, Academy of Sciences USSR)

34181
S/048/62/026/002/030/032
B117/B138

24,2200 (1147,1164,1482)

AUTHORS: Kirenskiy, L. V., Kan, S. V., and Savchenko, M. K.

TITLE: Behavior of the domain structure of thin ferromagnetic films at different temperatures

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 26, no. 2, 1962, 310 - 314

TEXT: This paper was presented at a conference on magnetism and antiferromagnetism. The authors studied the behavior of the domain structure of ferromagnetic films at different temperatures. Fe, Ni, Fe-Ni, and Fe-Ni-Mo films were produced by hot metal spraying in a vacuum (10^{-5} mm Hg) on to polished glass ($350^{\circ}C$) in a magnetic field of 120 oe. The optical device used for observation of the domain structure has already been described (Ref. 11: Kirenskiy, L. V., Kan, S. V., Degtyarev, I. F., Izv. AN SSSR, Ser. fiz., 25, no. 5 (1961)). The temperature dependence of the domain structure was studied on a specially designed apparatus (Fig. 1) with which the temperature in the specimens could be varied between -150 and $+650^{\circ}C$. To avoid misting and oxidation of the specimen in the chamber the pressure
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Behavior of the domain ...

was kept at 10^{-3} mm Hg during the experiments. In the absence of magnetic field the domain structure of all the specimens was highly stable. The behavior of the domain structure at various different temperatures is largely determined by the magnetic field strength. Magnetic reversal nucleation usually occurs in some sections of the film at quite low temperatures. With repeated magnetic reversal they are easily reproducible. At higher temperatures the number of nuclei increases, they grow, and the boundaries begin to move more rapidly and smoothly. When nuclei are formed magnetic reversal can only be achieved by increasing the temperature. H_s and H_o are temperature dependent. In some materials they decrease as the temperature rises. The curve for iron films at temperatures above 500°C showed an anomalous course, probably due to the different thermal expansion of base and film. There are 4 figures and 11 references: 3 Soviet and 8 non-Soviet. The three most recent references to the English-language publications read as follows: Smith D. O., Electronics, 32, 44 (1959); Murphy M., Control Engng., no. 10, 38 (1959); Olmen R. W., Mitchell E. N., J. Appl. phys., 30, 258 (1959).

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44648
S/126/62/014/006/019/020
E073/E420

24.2200

AUTHORS: Ivlev, V.F., Pak, N.G., Kan, S.V.

TITLE: Hysteresis loops in flat ferromagnetic films

PERIODICAL: Fizika metallov i metallovedeniye, v.14, no.6, 1962, 938-940

TEXT: There are no literary data on the hysteresis of isotropic films. To fill this gap ferromagnetic films were investigated which were produced by thermal evaporation of iron and of an alloy (17% Fe, 80% Ni, 3% Mo) from a tungsten crucible. The metallic vapour beam was at an angle of 15° to the substrate. Relatively thick iron films were deposited on glass discs (heated to 300°C) in a magnetic field of 100 Oe, by evaporation from an electrically heated iron wire. The metal layer was not covered by a layer of a dielectric. The magnitude and the direction of the magnetization vector changed during cyclic remagnetization and hence the flux of reflected polarized light also changed. Using the longitudinal Kerr effect by revolving the specimen or the remagnetization equipment relative to the plane of incident light a series of loops could be obtained from a single film in the same way as if mutually perpendicular measuring coils were used. There

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was good agreement between the hysteresis loops obtained for the same film, magneto-optically and by current methods. The rectangularity of hysteresis loops and the coercive force of a 2100 Å thick film showed no appreciable change on changing the angle between the direction of remagnetization and the plane of the incident light. Iron films exceeding 1000 Å were shown to be isotropic. The hysteresis behaviour of iron and molybdenum permalloy films, vacuum-deposited from tungsten crucibles indicated that they were uniaxially anisotropic. Hysteresis loops of 2100 and 450 Å thick iron films, recorded from various sections of the films, showed that in the isotropic films the coercive force of both sections was 6 and 7 Oe, whilst in the anisotropic films (vacuum-deposited from crucibles) the respective values were 27.7 and 30.8 Oe. The differences in the coercive force of individual sections of the thin films were explained by the irregular distribution of the nonuniformities. A correspondence was observed between the behaviour of the hysteresis loops and the domain structure. Remagnetization in isotropic films was by boundary displacement. The domain structure in very thin iron

S/120/63/000/001/033/072
E039/E072

AUTHORS: Pak, N.G. and Kan, S.V.

TITLE: A magneto-optical method for the presentation of hysteresis loops of ferromagnetic films on an oscilloscope

PERIODICAL: Pribory i tekhnika eksperimenta, no. 1, 1963, 133-134

TEXT: The apparatus consists of optical and electronic units. Light from a 400 W lamp is polarized and allowed to fall on the ferromagnetic film, which is mounted horizontally between two 16-cm diameter Helmholtz coils. These coils produce a field of ~150 Oe at the sample. The angle of incidence is 60° and the reflected light is polarized at an angle which depends on the magnetization of the sample. With cyclic remagnetization (at 50 c.p.s.) the value and direction of the angle of rotation of the plane of polarization changes continuously. The reflected light is passed through an analyzer and onto a photomultiplier, the output from which is fed to the vertical plates of the oscilloscope. The signal for the horizontal plates is taken from the Helmholtz coil circuit. The rotation of the plane of polarization for an
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A magneto-optical S/120/63/000/001/033/072
E039/E072

iron film is 0.5 to 0.7° and somewhat smaller for permalloy. Hysteresis loops can be obtained for permalloy films with diameters of not less than 5 mm. The effect of magnetization on domain structure is illustrated. This method is simple and can be used over a wide range of frequencies and temperature. There are 4 figures.

ASSOCIATION: Institut fiziki CO AN SSSR
(Institute of Physics, SO AS USSR)

SUBMITTED: April 7, 1962

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S/0048/64/028/001/0157/0160

AP4010312

AUTHOR: Pak, N.G.; Kan, S.V.; Savchenko, M.K.

TITLE: Hysteresis loops and domain structure of ferromagnetic films at different temperatures /Report, Symposium on Questions of Ferro- and Antiferromagnetism held in Krasnoyarsk, 25 June to 7 July 1962/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v.28, no.1, 1964, 157-160

TOPIC TAGS: thin films, ferromagnetic films, hysteresis loop, domain structure, cobalt, iron, molybdenum permalloy, coercive force, magnetic anisotropy

ABSTRACT: Although there have been many experimental investigations of the temperature dependence of the magnetic properties of ferromagnetic films, most of these, however, have been concerned with the temperature dependence of the saturation magnetization. Yet the temperature dependence of other magnetic properties of thin films are also of interest, particularly in view of the fact that thin film memories are required to operate at temperatures in the range from -100 to 300°C. The present work was concerned with investigation of the hysteresis loops and domain structure of thin films of iron, cobalt and Mo permalloy (17% Fe, 80% Ni and 3% Mo)

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at different temperatures. The domain structure was observed by means of the meridional Kerr effect. The permalloy and cobalt films were prepared by vacuum evaporation from a tungsten crucible in a 100 Oe field. The iron films were evaporated directly from an iron wire heated by passage of current. The films were deposited on cover glasses heated to 150°C. The vacuum curing the evaporation operation was about 8×10^{-6} mm Hg. The hysteresis loops were recorded in the direction of the axis of easy magnetization for different directions of the applied field. The hysteresis loops for a 1600 Å thick cobalt film at temperatures from 20 to 320°C and different directions of the switching field are reproduced in a figure. At room temperature the best squareness ratio and the greatest value of the coercive force in the easy magnetization direction are observed with the field applied in the same direction ($\alpha = 0^{\circ}$). Slight rotation of the reversing field gives rise to distortion of the horizontal sections of the loop, which is indicative of rotation processes. With increase in temperature the loops narrow. The initial properties of the film are not re-established upon cooling to room temperature. The behavior of Mo permalloy films is different: these films retain their anisotropy after heating and cooling. The coercive force versus temperature curves obtained for the different films are reproduced in Fig.1 of the Enclosure. Photographs of the domain structure of 1600 Å thick cobalt and iron films in the process of magnetization re-

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versal at different temperatures are reproduced in the text. On the basis of the experimental results it is concluded that cobalt films become isotropic at about 320°C but do not return to the initial anisotropic state upon subsequent cooling. Permalloy films, on the contrary, regain their initial properties after cooling. In iron films, there form two mutually perpendicular groups of domains. Orig.art.has: 4 figures.

ASSOCIATION: Institut fiziki Sibirskogo otdeleniya Akademii nauk SSSR (Institute of Physics, Siberian Division, Academy of Sciences, SSSR); Krasnoyarskiy pedagogicheskiy institut (Krasnoyarsk Pedagogical Institute)

SUBMITTED: 00 DATE ACQ: 10Feb64 ENCL: 01

SUB CODE: PH, CP NR REF SOV: 003 OTHER: 006

Card 3/4 3

ACCESSION NR: AP4023407 S/0048/64/028/003/0559/0567

AUTHOR: Kirenskiy, L.V.; Savchenko, M.K.; Degtyarev, I.F.; Kan, S.V.; Antipin, I.P.; Tropin, Yu.D.; Edel'man, I.S.

TITLE: Domain structure of ferromagnetic crystals, films, and whiskers, and changes of the structure under the influence of different factors /Report, Symposium on Ferromagnetism and Ferroelectricity held in Leningrad 30 May to 5 June 1963/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v.28, no.3, 1964, 559-567

TOPIC TAGS: crystal domain structure, film domain structure, whisker domain structure, domain structure variation, demagnetization condition domain influence, iron crystal domains, iron film asymmetric hysteresis, iron whisker domain

ABSTRACT: This paper summarizes a large amount of information concerning the domain structure of crystals, films, and whiskers, and its change under the influence of magnetizing fields, stress, temperature, and conditions of demagnetization. The topics discussed include the changes in the domain structure of silicon iron crystals during magnetization in various directions; the effect of mechanical stress on the domain structure of silicon iron crystals; the influence of mechanical stress

ACCESSION NR: AP4023407

on the domain structure in the (110) and (211) faces of nickel crystals; the effect of demagnetization rate on domain size in thin cobalt films; the effect of temperature on the variation of domain structure under the influence of magnetizing fields in thin cobalt films; the variations of domain structure in thin iron films during traversal of an asymmetric hysteresis loop in a transverse field; and the domain structure on the (001) surface of iron whiskers (100 to 200 micron diameter) grown in the [110] direction. The report is illustrated with 47 reproductions of domain structure photographs. Among the different kinds of behavior of domain structure mentioned or discussed are the following. When iron crystals are magnetized in the easy direction, the process of domain wall motion stops short of saturation, and the remaining narrow unfavored domains disappear suddenly. When the magnetizing field makes a sufficiently great angle with the preferred magnetization direction, initial magnetization takes place by domain wall shift; this is followed by a restructuring of the domains, after which further wall shifting occurs. The final approach to saturation is by ordinary rotation. The herring bone or fir tree domain structure on the (110) face of nickel crystals gives way under the influence of mechanical stress to a simple structure. At greater stresses the domains disappear entirely. At still greater stresses a simple domain structure reappears, but the domains are now relat-

ACCESSION NR: AP4023407

ed to the other magnetization axis. The net result is thus a 109° rotation of the domains. The size of the domains in cobalt films increases with the rate of demagnetization by alternating field. This is related to the formation of wedge shaped domains, one within another. When a thin cobalt film is cooled from above the Curie point in a field free environment, an equilibrium domain structure is not formed. The domain structure of a thin iron film was found to change largely by wall shift during traversal of an asymmetric hysteresis loop in the presence of a constant transverse field. This is not in accord with the explanation of these asymmetric hysteresis loops given by V.V.Kobelev (Petli gisterezisa odnoosny*kh ferromagnitny*kh plenok. ITM i VT AN SSSR,M.,1961) on the basis of a model in which the magnetization was assumed to rotate uniformly. Orig.art.has: 9 figures.

ASSOCIATION: Institut fiziki Sibirskogo otdeleniya Akademii nauk SSSR(Institute of Physics, Siberian Division, Academy of Sciences,SSSR); Krasnoyarskiy pedagogicheskiy institut (Krasnoyarsk Pedagogical Institute)

SUBMITTED: 00 DATE ACQ: 10Apr64 ENCL: 00

SUB CODE: PH NR REF SOV: 005 OTHER: 003

Card 3/3

KAN, S.V.; OLEVSKIY, V.M.; RUCHINSKIY, V.R.; KOCHERGIN, N.A.; BESSMERTNAYA, A.I.

Studying mass transfer and liquid distribution in a tower with plane-parallel packing. Khim. prom. 41 no.10:770-773 O '65.
(MIRA 18:11)

L 15384-66 EWT(1)/EWP(e)/EWT(m)/EWA(d)/T/EWP(t)/EWP(z)/EWP(b) IJP(c) JD/WW/GG/

ACC NR: AP6004461 GG SOURCE CODE: UR/0048/66/030/001/0031/0033

AUTHOR: Rusova, S.G.; Kan, S.V.

78

ORG: Institute of Physics, Siberian Section of the Academy of Sciences, SSSR (Institut fiziki Sibirskogo otdeleniya Akademii nauk SSSR)

B

TITLE: Stability of the coercive force of thin films /Transactions of the Second All-Union Symposium on the Physics of Thin Ferromagnetic Films held at Irkutsk 10 July to 15 July, 1964/

SOURCE: AN SSSR. Izvestiya.Seriya fizicheskaya, v.30, no. 1,1966, 31-33

TOPIC TAGS: ferromagnetic film, magnetic thin film, quartz, iron, permalloy, molybdenum, magnetic coercive force, storage effect, atmospheric humidity, oxidation

ABSTRACT: Eighty films of iron and 17Fe-79Ni-4Mo Permalloy with and without quartz coverings were stored for 200 days at different temperatures and under different conditions of relative humidity, and their coercive force was measured from time to time. The films were vacuum deposited (10^{-5} mm Hg in a magnetic field of 100 Oe to thicknesses from 400 to 1100 Å onto glass substrates that had been baked out for 4 hours and were maintained at 200° during deposition. On some of the films a 1000 Å layer of quartz was deposited without breaking the vacuum; on other films a 3000 Å layer of quartz was deposited after the film had been exposed to air for 30 min; and a third group of films were left uncovered. The coercive forces were measured after

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PAK, N.G.; KAN, S.V.

Domain structure and coercive force of thin films at different field frequencies. Izv. AN SSSR. Ser.fiz. 30 no.1:80-82 Ja '66. (MIRA 19:1)

1. Institut fiziki Sibirskogo otdeleniya AN SSSR i Krasnoyarskiy gosudarstvennyy pedagogicheskiy institut.